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Maritimes Region

Canadian Science Advisory Secretariat
Science Response 2016/036

4VWX HERRING 2016 UPDATE REPORT

Context

Maritimes DFO Resource Management has requested that DFO Science provide an update on the science advice for NAFO Divisions 4VWX Atlantic Herring (*Clupea harengus*) management unit in support of the 2015/2016 fishery. The last assessment of 4VWX herring stock was conducted in March 2015 (DFO 2015). The biological and fishery information of the 4VWX herring stock forms the basis for establishing quota for the 2015/2016 fisheries, as required in the Integrated Fisheries Management Plan (IFMP). This Science Response reviews and updates biological and fishery information of the 4VWX herring stock including an evaluation of the southwest Nova Scotia/Bay of Fundy (SWNS/BoF) spawning component, a compilation and review of information regarding the offshore Scotian Shelf spawning component and the coastal Nova Scotia (NS) spawning component, an update on southwest New Brunswick (SWNB) migrant juvenile fishery component, and an evaluation of the status of the fishery with respect to the conservation Limit Reference Point (LRP). This Response also reviews whether the goals of the rebuilding plan are being met.

This Science Response Report results from the Science Response Process April 6, 2016, on the Stock Status Update of Herring in Northwest Atlantic Fisheries Organization (NAFO) Fishing Area 4VWX.

Background

The 4VWX herring management unit contains a number of spawning areas, separated to various degrees in space and time. For the purposes of evaluation and management, the 4VWX herring fisheries are divided into four components (see the Appendix for map of place names):

- SWNS/BoF spawning component (includes Scots Bay, German Bank, and Trinity Ledge);
- Offshore Scotian Shelf spawning component (includes The Patch and Western Hole);
- Coastal (South Shore, Eastern Shore, and Cape Breton) NS spawning component; and
- SWNB migrant juveniles (NB weirs).

Each component except SWNB migrant juveniles has several spawning areas, and there is mixing of fish among spawning components outside of the spawning period. The Total Allowable Catch (TAC) for the SWNS/BoF is 50,000t. The Offshore Scotian Shelf has an allocation of 12,000t, and the coastal NS fishing areas have allocations based on the recent 5-year averages of observed spawning stock biomass (SSB[1]).

The 2003 (Evergreen) Scotia-Fundy Herring IFMP set out principles, conditions, and management measures for the 4VWX herring fisheries (DFO 2003). The main principle stated in the plan is "the conservation of the herring resource and the preservation of all of its spawning components". The three conservation objectives are: to maintain the reproductive capacity of herring in each management unit, to prevent growth overfishing, and to maintain ecosystem integrity/ecological relationships ("ecosystem balance"). Progress against these conservation

[1] Throughout this document, spawning stock biomass (SSB) refers to the spawning stock biomass observed at the time of the acoustic surveys.

Canada

objectives was evaluated during the March 2015 assessment (DFO 2015). A major review of the assessment framework was conducted in 2006/2007 (DFO 2007) followed by a framework meeting in 2011. A model was not chosen during the framework meeting; however, recommendations for the assessment were provided (DFO 2011). In 2012, a conservation LRP of 377,272t, the average SSB in Scots Bay and German Bank for the period 2005-2010, was set (Clark et al. 2012). The total SSB in these two areas is evaluated based on the 3-year moving average with respect to this LRP.

The herring fisheries in 4VWX have always been dominated by purse seine (e.g. 81-99%, 1981-2015). Other gear types include weir, gillnet, shutoff, and trap.

Analysis and Response

Landings

The landings for the period October 15, 2014, to October 14, 2015, (the 2014/2015 quota year) were 49,024t against a TAC of 50,000t for the SWNS/BoF component (Table 1).

Table 1. Reported landings (rounded to thousands of tonnes) and total allowable catch for the 4VWX herring management unit by component from 2006 to 2015 with averages for recent and prior decades.

Year	Avg. 1970 -79	Avg. 1980 -89	Avg. 1990 -99	Avg. 2000 -09	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
4WX SW Nova Scotia/ Bay of Fundy TAC[1]	108	108	112	69	50	50	55	55	55	50	50	50	50	50
4WX SW Nova Scotia/Bay of Fundy[1]	131	131	86	65	50	50	55	54	46	50	48	47	50	49
4WX Coastal Nova Scotia[2]	+1	+1	4	7	7	5	4	10	6	4	3	4	5	5
Offshore Scotian Shelf[2]	39	+0.1	13	6	10	5	1	9	12	10	1	2	+0.1	2
SW New Brunswick[2]	26	24	24	15	13	31	6	4	11	4	1	6	2	+0.2
Total Landings	172	155	127	93	79	92	66	77	74	68	52	58	57	56

1 - Quota year from October 15th of the preceding year to October 14th of the current year
2 - Calendar year from January 1st to December 31st

Additional landings of 7,102t were taken in the non-quota stock components (outside the quota area) for a total of 56,126t. Southwest NB weirs and shutoffs landings in 2015 decreased to 146t (Table 1), a historical low. The landings increased for the Offshore Scotian Shelf but remained below the 12,000t allocation for the area. Landings for the 4VWX Coastal NS component, primarily from gillnet gear type, remained approximately the same at 5,166t. Within the SWNS/BoF component, there was a decrease in catches from the German Bank area defined as the acoustic catch box from 50% of the total TAC in 2014 to 42% in 2015. Within this catch area, purse seiners decided on a cap of 50% of the TAC in 2013 and 40% in 2014 for implementation in the subsequent fishing years. Landings by defined fishing grounds decreased in 2015 from Grand Manan, Gannet Dry Ledge, and Long Island and increased for Scots Bay and NB Coastal. For SWNS/BoF, landings in 2015 were 1,200t (2%) less than in 2014.

Southwest Nova Scotia/Bay of Fundy

Age Structure

The 2015 fishery catch-by-number (Figure 1) was dominated by 2-year olds (40% overall) with widespread occurrence in all areas except on the main spawning grounds in Scots Bay and German Bank, where the landings are dominated by mature fish. Catch-by-weight was dominated by ages 2, 4, and 7 (at 15-18%) with age 4 dominating slightly. Age 4 catches were largest in the month of June, particularly in the Scots Bay, German Bank, and Gannet/Dry Ledge areas. Another important feature of the 2015 catch-at-age was the generally even distribution of ages 3 to 8 in terms of number and weight with an overall increase in numbers of

ages 7+ from 11% in 2014 to 15% in 2015. Based on the age structure, the total number of fish removed by the fishery in 2015 was estimated to be 5 million fish (1%) less than in 2014. In 2015, a greater number of age 8 and 9 fish were landed than in the previous 5 years, but the numbers of fish aged 6 and older in the commercial landings are less than those in the 1965-1995 time period (Figure 2).

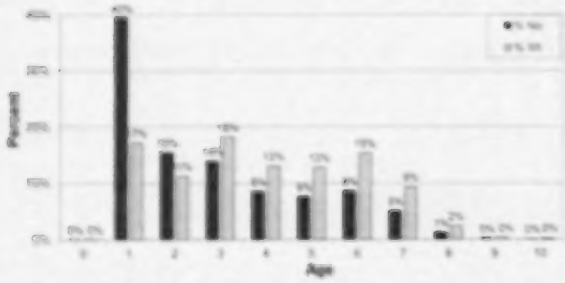

Figure 1. Fishery catch-at-age (percentage numbers and percentage weight) for Southwest Nova Scotia/Bay of Fundy spawning component (2014-2015 quota year).

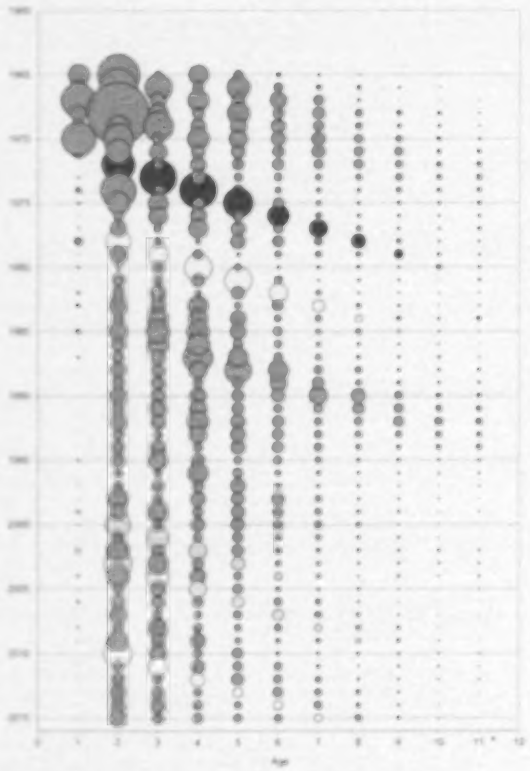

Figure 2. Historical relative numbers-at-age (denoted by circle size) in the commercial landings for Southwest Nova Scotia/Bay of Fundy spawning component from 1965-2015. Selected strong year-classes are indicated by colours.

The acoustic surveys catch-at-age continues to have a broad age distribution of spawning fish from ages 3-11. In the acoustic surveys catch-at-age, the proportion of fish (by numbers)-at-age 6 and older was 41% (same as in 2014). In the fishery, the proportion of fish (by numbers)-at-age 6 and older was 23% (22% in 2014), which is substantially lower than the acoustic surveys catch at age due to the inclusion of juveniles. The mean age acoustic catch-at-age increased slightly to 5.3 years in 2015 from 5.0 years in 2014 and is the highest value since 2007. Age 4 fish were dominant in the 2015 Scots Bay surveys (34% by number) followed by age 7 fish at 18%. German Bank was equally represented by age 4 and 5 fish at 28% and 25%, respectively. The overall acoustic age composition indicates the incoming 2011 year-class (at age 4) as relatively strong while the 2007 and 2008 year-classes (ages 7-8) remain important in the spawning component (Figure 3).

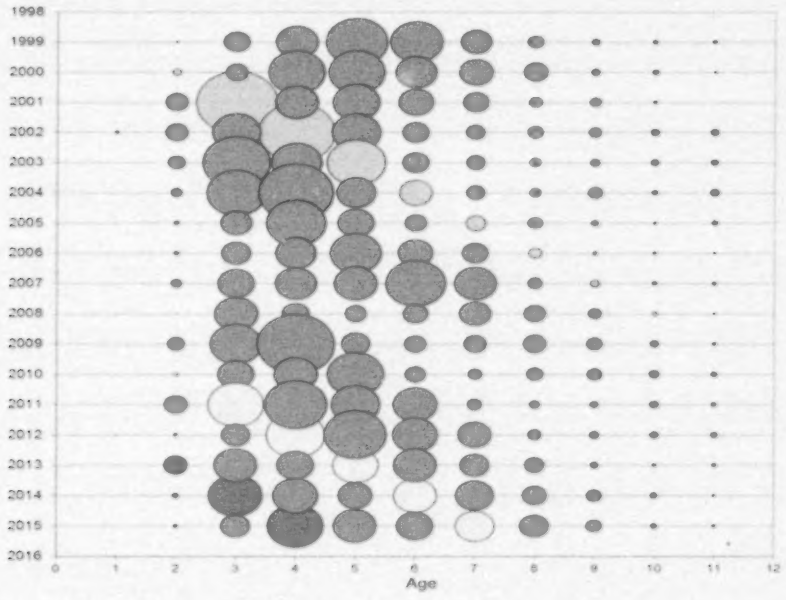

Figure 3. Relative numbers-at-age (denoted by circle size) in the acoustic catch-at-age for southwest Nova Scotia/Bay of Fundy spawning component from 1999-2015. Selected strong year-classes are indicated by colours.

Acoustic Surveys

Table 2 summarizes the results of the 2015 acoustic surveys for the SWNS/BoF component. Inbox and outbox refers to survey tracks within and outside the designated survey boxes, respectively. There were 6 surveys in Scots Bay, 5 on German Bank (3 other surveys were excluded), and 1 on Trinity Ledge (1 other survey was excluded). Excluded surveys were not used because they were conducted less than 10 days after the previous survey.

The overall acoustic biomass estimates (Scots Bay, Trinity Ledge, and German Bank) decreased slightly in 2015 to 462,241t (95% confidence interval (C.I.): +/- 32,036t) from 463,929t (95% C.I.: +/- 43,393t) in 2014. This moves the overall acoustic biomass estimate to 3% above the long-term average (1999-2015) of 450,447t. Most of the increase occurred in Scots Bay with 285,194t (95% C.I.: 26,242t) in 2015 and 226,123t (95% C.I. +/- 29,542t) in 2014. The German Bank SSB decreased from 233,034 (95% C.I.: +/-65.854t) to 176,389 (C.I.: +/- 41.899t) in 2015, the lowest biomass estimate recorded since surveys began. Caution is warranted in this area as a result of this continuing downward trend.

Table 2. Acoustic surveys spawning biomass index for Southwest Nova Scotia/Bay of Fundy spawning component for 1999 to 2015 (rounded to thousands of tonnes).

Location/Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average 2005-2010*	Average 1999-2015
Scots Bay (inbox)	46	185	216	129	123	115	21	32	51	23	82	42	106	144	67	221	260	42	110
Scots Bay (outbox)	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	2	0	6	12	35	41	9	5	25	11	15
Scots Bay Total	46	185	216	129	123	115	21	32	53	23	88	54	141	185	76	226	285	45	118
German Bank (inbox)	495	334	257	416	349	392	269	291	495	239	396	235	289	278	254	230	176	321	317
German Bank (outbox)	n/d	n/d	n/d	n/d	n/d	n/d	n/d	5	4	2	2	19	11	10	11	3	0	6	7
German Bank Total	495	334	257	416	349	392	269	295	499	241	398	254	300	288	265	233	176	326	321
Scots Bay and German Total	541	519	473	546	472	507	290	327	552	264	485	308	441	473	341	459	462	371	439
Trinity Ledge	4	1	15	9	12	12	11	16	3	1	2	2	7	3	1	5	1	6	6
Spec Buoy (spring)	n/d	n/d	1	n/d	1	n/d	1	n/d	0	0	n/d	2	0	n/d	n/d	n/d	n/d	1	1
Spec Buoy (fall)	n/d	n/d	88	n/d	n/d	n/d	n/d	0	n/d	n/d	n/d	n/d	n/d	n/d	n/d	0	0	0	44
Overall Stock Area	545	521	577	554	485	519	301	343	556	265	487	312	449	476	342	464	462	377	450
Seal Island	n/d	n/d	4	1	12	n/d	n/d	10	n/d	n/d	n/d	n/d	1	n/d	n/d	n/d	n/d	10	6
Browns Bank	n/d	n/d	45	n/d	n/d	n/d	n/d	8	n/d	n/d	n/d	n/d	n/d	n/d	n/d	0	0	8	26
Total All Areas	545	521	626	556	497	519	301	361	556	265	487	312	450	476	342	464	462	380	455

* Note: Average 2005-2010 = Limit Reference Point (German Bank and Scots Bay total only)
n/d = no data for that year in that category
Zero = surveys conducted but the numbers recorded were either 0 or less than 500t (rounds to 0 thousand t)

Limit Reference Point

The 3-year moving average for the acoustic surveys estimate (Scots Bay and German Bank combined) is above the LRP point by 13 % and 12 % in 2014 and 2015, respectively (Figure 4). Although the 2015 acoustic surveys estimate (461,600t) increased, the 3-year moving average (420,500t) decreased slightly from the 2014 estimate resulting in little change in the last two years.

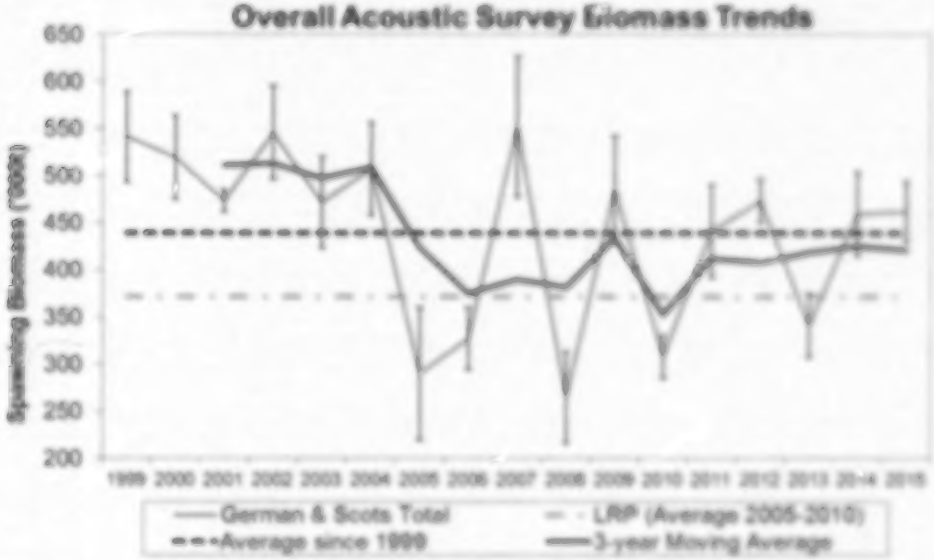

Figure 4. Relative spawning stock biomass index (with 95% standard errors), the calculated 3-year moving average, the average since 1999, and the limit reference point (LRP) for the Southwest Nova Scotia/Bay of Fundy spawning component (German Bank and Scots Bay).

Offshore Scotian Shelf Component

In 2015, offshore landings increased to 1,809t from 58t in 2014 (Table 1); however, landings remain below the allocation limit of 12,000t. Most landings were caught by purse seiners in May and June, in the vicinity of The Patch (see map in the Appendix). The age composition of the commercial catch was primarily adult herring with ages 5, 6, and 7 dominating by numbers (64%) and weights (67%). An additional by-catch of 40t was reported from groundfish otter trawl fisheries for Silver Hake on the Scotian Shelf. The DFO summer Research Vessel survey mean catch-per-tow for the 4WX offshore area increased to 167 fish from 91 in 2014.

Coastal (South Shore, Eastern Shore and Cape Breton) Nova Scotia Spawning Component

Allocations for the coastal NS spawning component are based on the recent 5-year average of observed acoustic SSB, where available. Landings in the Little Hope/Port Mouton area increased in 2015 to 4,160t (from 3,596t in 2014) against the 2015 allocation of 3,772t (Table 3). In the Eastern Shore area, landings decreased in 2015 to 1,001t (from 1,163t in 2014) against the 2015 allocation of 1,066t. No landings were reported for Glace Bay in 2015. The Bras d'Or Lakes area remained closed to herring fishing. In 2015, the age composition of the catch for the coastal component was primarily adult herring from this size selective gillnet fishery with a substantial proportion of the catch (94% by numbers) age 5 and older.

In 2015, the SSB for the Little Hope/Port Mouton area increased to 145,399t from the 46,077t in 2014, the highest since surveys started and well above the recent 5-year average of 61,511t (Table 4). The SSB in the Halifax/Eastern shore area also increased to 68,562t (2015) from 9,566t (2014) and above the recent 5-year average of 16,837t. The reason for these increases is not known and could be an anomaly rather than an increase in abundance. The same survey protocols were used in 2015 as in previous years. There was no evidence of a large influx of first time spawners or spawning in new areas. Caution is always warranted in applying the survey SSB as an absolute tonnage of herring in the water.

No survey was completed in Glace Bay in 2015 and no catch was reported.

Table 3. Recorded landings and allocations (tonnes) of herring from major gillnet fisheries on the Coastal Stock Scotia spawning component for 2008 to 2018.

Landings and Allocations (t)	Avg. 98-07	2008	2007	2008	2009	2010	2011	2012	2013	2014	2015
Little Hope/Port Mouton	Catch	1,301	1,470	1,110	1,108	1,711	1,108	1,110	1,102	1,468	1,108	1,102
	Allocation	1,398	1,853	1,835	1,848	1,113	1,454	1,398	1,398	1,797	1,417	1,113
Hartlen/Eastern Shore	Catch	1,348	1,500	1,702	1,348	1,868	1,503	928	971	1,500	1,703	1,347
	Allocation	1,205	4,223	3,387	3,705	3,857	4,171	4,198	3,005	3,457	1,848	1,848
Diana Bay	Catch	140	90	45	0	0	0	0	0	0	0	0
Brier (CI) Lakes	Catch	34	0	0	0	0	0	0	0	0	0	0

*original allocation of 2,307t was increased by 400t

Table 4. Estimated herring annually spawning stock biomass (SSB) (tonnes) and recent 5-year average for the Coastal Stock Scotia spawning component areas.

Acoustic Survey SSB (t)	Avg. 98-07	2008	2007	2008	2009	2010	2011	2012	2013	2014	2015	5-y Ave'd 2003
Little Hope/Port Mouton	29,394	24,110	1,400	4,000	36,000	36,700	36,700	17,700	4,110	46,371	106,300	31,010
Little Hope Allocation	1,398	1,853	1,835	1,838	1,848	1,113	1,454	1,398	1,797	1,417	1,113	1,848
Hartlen/Eastern Shore	31,944	66,400	26,300	32,000	64,300	27,700	7,000	7,000	9,970	9,000	46,300	36,000
Hartlen Allocation	1,205	4,223	3,387	4,705	3,747	4,171	4,198	3,005	3,457	1,848	1,848	3,313
Diana Bay	2,114	n/a	300	500	100	0	0	n/a	50	n/a	n/a	97
Brier (CI) Lakes	300	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

n/a – no survey. *original allocation of 2,307t was increased by 400t

[redacted] New Brunswick Migrant committee

The New Brunswick [redacted] and short-of-fishery [redacted] migrant juvenile herring, in [redacted] landings decreased from [redacted] in [redacted] to a historical low of [redacted] in [redacted]. Total [redacted] in this New Brunswick [redacted] and shortliff fishery were primarily juveniles [redacted] age 1 and [redacted] at age 2 by numbers. The number of years with catches decreased in [redacted] 1 more (in [redacted]).

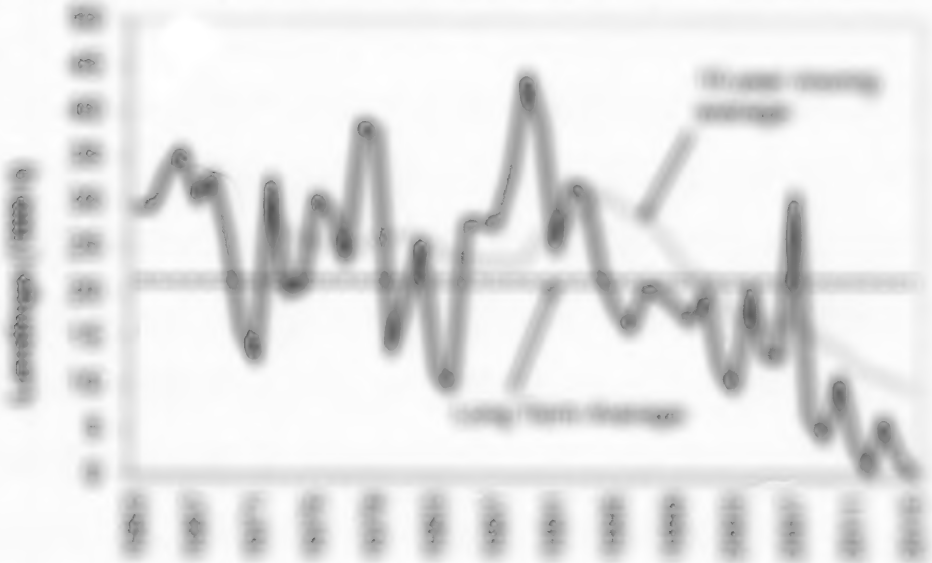

Figure 1. Herring landings (tons) from Southmoor New Brunswick weir and shortliff fishery from [redacted] with long-term average and 5-year moving average.

[redacted]

Southmoor [redacted] Juvenile Stock at Priority Spawning Components

The juvenile spawning stock biomass estimate decreased slightly. There was an increase in Knock Bay and a decrease on Hammer Neck. Although there is uncertainty in the juvenile biomass estimates, the longer-term trends show an increasing trend in Knock Bay since [redacted] and a decreasing trend in the Hammer Neck area from [redacted] present. In [redacted], a historical low biomass was recorded on Hammer Neck. The decreasing trend indicates that stocks in assessed on Hammer Neck. The [redacted] for Trinity remains low relative to values observed in the early [redacted].

The 5-year moving average decreased slightly and, as such, a harvest strategy that continues to maximize exports is warranted. The model-type ranges observed in the combination each indicates that the conservation objective is generally being met. Table 5 provides a summary of the stock options and considerations for each of the corresponding objectives in the PSAR.

Table 2: [illegible]

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Appendix

Appendix 1. Place names and fishing locations for SWNB/BoF, coastal NS (South Shore and Eastern Shore), Offshore Scotian Shelf and SWNB weirs. The vertical blue line indicates the outer boundary of the SWNS/BoF stock component.

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